DEVELOPMENT OF POLLUTION CONTROL CRITERIA

for

INTEGRATED IRON AND STEEL PRODUCTION

VOLUME 1

SUMMARY REPORT

British Columbia Steel Task Force

November 1990

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for

British Columbia Steel Task Force

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Dr. K. Bindra	B.C. Ministry of Environment
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Expert Reviewers are as follows:

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PREFACE

In support of the pre-feasibility study conducted jointly by the Province of British Columbia and the China Steel Corporation of Taiwan, the B.C. Ministry of Environment formed the B.C. Steel Task Force to develop pollution control criteria for a proposed integrated steel mill.

The recommended criteria are draft discharge criteria developed on the basis of a detailed assessment of the best available discharge technology and the state-of-the-art steel-making processes. The starting point for assessment of the environmental protection measures is the best available technology. Eventually, factors such as environmental quality and economics are to be considered to set the site-specific conditions. These criteria are guidelines and as such generally not binding until they are applied to individual permits. They are also always to be seen as provisional, to be adjusted in accordance with technical developments and further knowledge of environmental impacts. The draft criteria document has been prepared in a very short time frame which included a peer review by a team of international experts in a workshop.

This document may warrant some editorial improvements. Hopefully, it contains the basic material which will be useful for the initial site evaluation and for any subsequent feasibility and environmental studies for an integrated steel mill.

B.B. Manna
Chairman
B.C. Steel Task Force

1.0 INTRODUCTION

1.0 Introduction

Proposed pollution control criteria and a compliance monitoring regime have been developed for an integrated iron and steel plant for the British Columbia Steel Task Force. These proposed criteria are based on the most commercially advanced production and pollution control technology that was identified in the study.

The details of the integrated iron and steel production processes, pollutant generation, pollution control technology and selected production and pollution control model processes are contained in Volume 2: Background Report, which also contains the background for the selection of pollution control criteria proposed in Volume 1.

The pollution control criteria are based on a three-million-tonne-capacity plant using the production and pollution control processes identified in Volume 2.

The pollution control criteria are expressed in concentration units. In the case of the wastewater discharge of pollutants to the environment, process weight units are also used. These process weight units are normalized to kg per tonne of crude steel (molten steel tapped from the steel-making furnace into the ladle but before further processing).

In those cases where the pollution source creates fugitive-type pollutant discharges, pollution control measures are proposed that would reduce the fugitive-type emissions to the lowest level feasible.

1.1 Integrated Iron and Steel Plant

An integrated iron and steel plant processes raw materials into semi-finished or finished steel products for use as raw materials in other manufacturing processes. The basic production processes are iron making, steel making, hot forming and cold forming and are briefly outlined below and described in detail in Volume 2.

Figure 1.1 shows the principal process steps involved in converting raw materials into the major product forms (semi-finished or finished).

Iron Making:

Iron ore is usually up-graded at the mine site or elsewhere by removing some of the impurities. It is then smelted in a blast furnace to produce molten iron. Other raw materials such as lime or limestone are used in the process to remove the balance of the impurities. Coke made from coal in coke ovens is used as a reductant in the blast furnace to remove the oxygen from the iron ore.

Steel Making:

Steel is usually produced by one of two processes. The one most widely used for integrated steel plants is the basic oxygen process where oxygen is blown into the molten iron to produce molten steel. The second process is the melting of steel scrap and, in some cases, pre-reduced iron ore in an electric arc furnace. The molten steel is usually cast to the appropriate shape in a continuous casting machine.

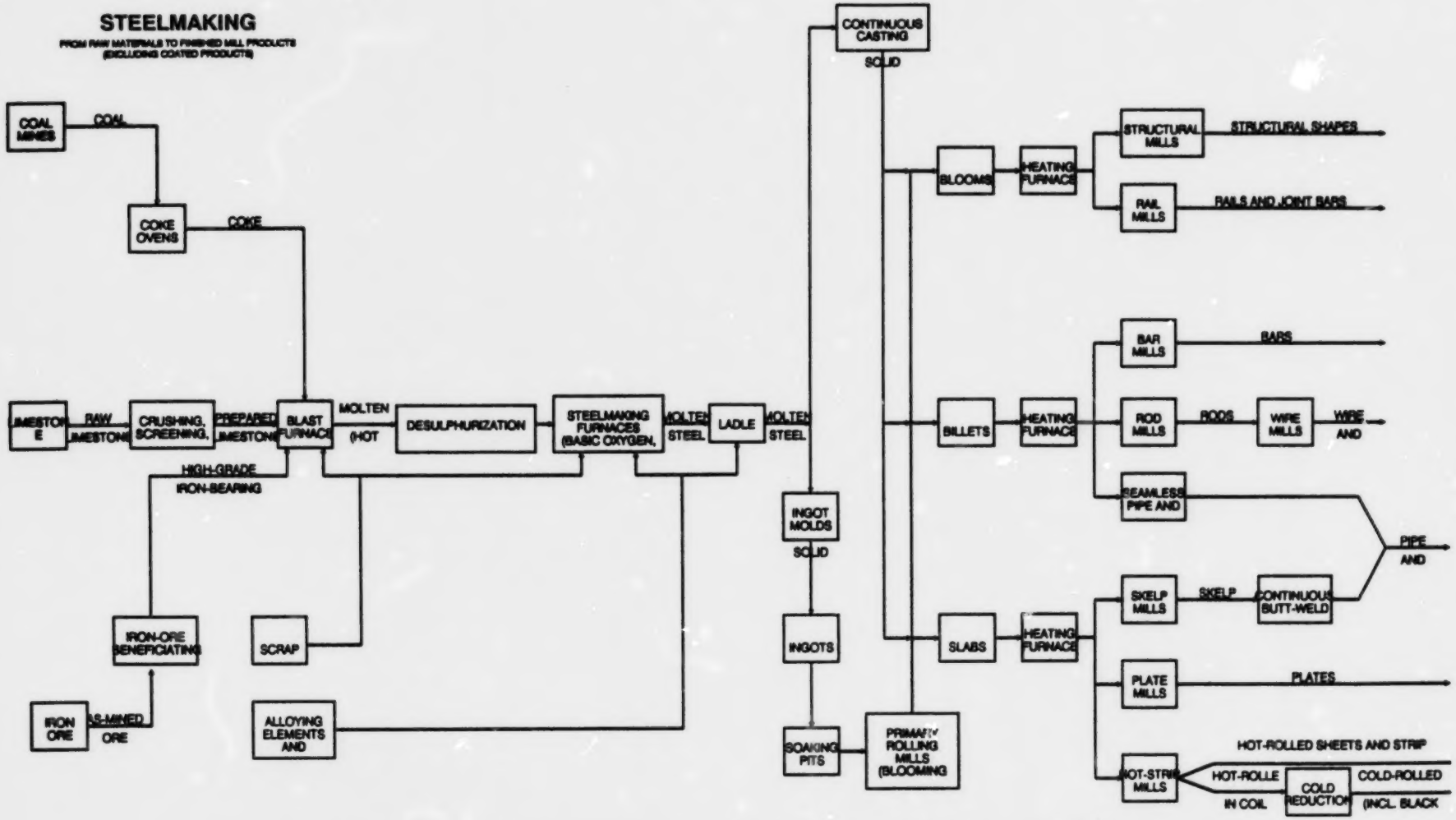

Fig. 1.1 Flow diagram showing the principal process steps involved in converting raw materials into the major product forms, excluding coated products.

Hot Forming:

The hot steel is formed into an intermediate or semi-finished product such as plate, strip or structural shapes by passing the steel through one or more rolling mills.

Cold Forming:

The material produced by hot forming is further processed to final form or finished product. These processes include cold rolling to form the desired shape, annealing, acid pickling to remove scale and surface imperfections and coating such as galvanizing.

Pollution and Pollution Control:

Section 3.0 of Volume 2 describes and quantifies the pollution arising from the various production processes. Section 4.0 of Volume 2 describes the pollution control technology used for the various production processes and the degree of pollution control that can be achieved.

2.0 PROPOSED POLLUTION CONTROL CRITERIA

2.1 Introduction

The proposed pollution control criteria have been developed for the wastewater discharge to the environment, Section 2.2, for the air emissions to the environment, Section 2.3, and for solid waste, Section 2.3.

The pollution control criteria have been developed on the concept of a three-million-tonne-capacity plant model. The production processes and technologies and the pollution control technologies selected in the model have been used as a basis to develop the pollution control criteria. Their use is not mandatory for an integrated iron and steel plant operator.

The selection of specific pollutants for which control criteria have been developed has been based on the pollutants normally encountered in a steel plant and on the relationship with other pollutants in the various processes. Thus, for example, the control of benzene and PAH from the coke ovens ensures that other hydrocarbon compounds are controlled and do not need specific control criteria. Similarly some pollutants can serve as surrogates for other pollutants which will not require specific control criteria.

For steel plants with production above three million tonnes per year the total pollutant discharge is reduced per tonne of steel produced. At a production level of four and one half million tonnes per year the process weight pollution control criteria would be reduced to 85 percent of their base level and at the six million tonnes per year level the process weight pollution control criteria would be reduced to 70 percent of their base level.

The reduction per unit of production is shown in Figure 2.0.

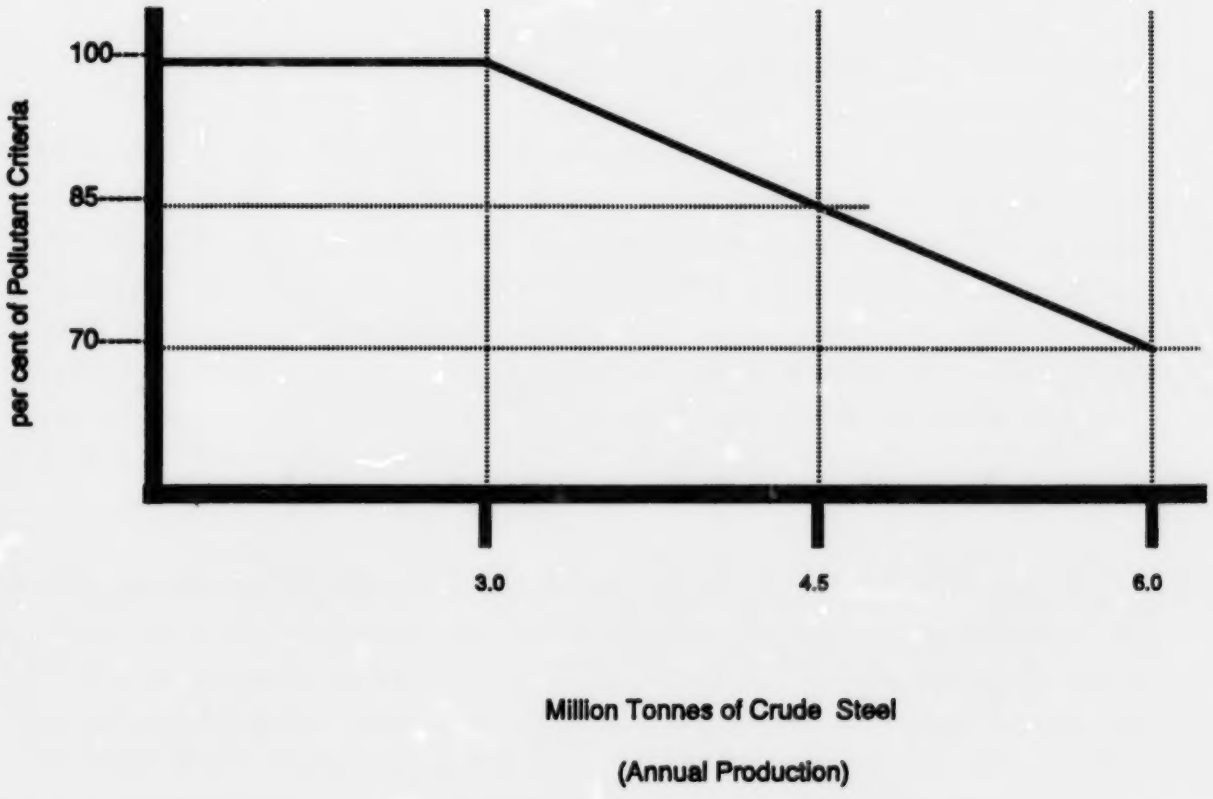

Figure: 2.0 Pollutant Criteria versus Crude Steel Production Rate

2.2 Plant Discharge Criteria

2.2.1 Wastewater Discharge:

The proposed pollution control criteria for the process wastewater discharge are shown in Tables 2.2.2, 2.2.3 and 2.2.4. The model process water flows from the various process units are shown in Table 2.2.1. Specific pollution control measures for fugitive-type sources of benzene are shown in Table 2.2.5. The requirements for precipitation run-off water are contained in Section 2.2.1.1.

Note that all pollution control criteria are to **both fresh water and the marine environment.**

The flow sheet for the sequential integrated wastewater treatment system on which the pollution control criteria are based is shown in Figure 5.3.1. The references noted on this figure refer to Section 5.0 of Volume 1.

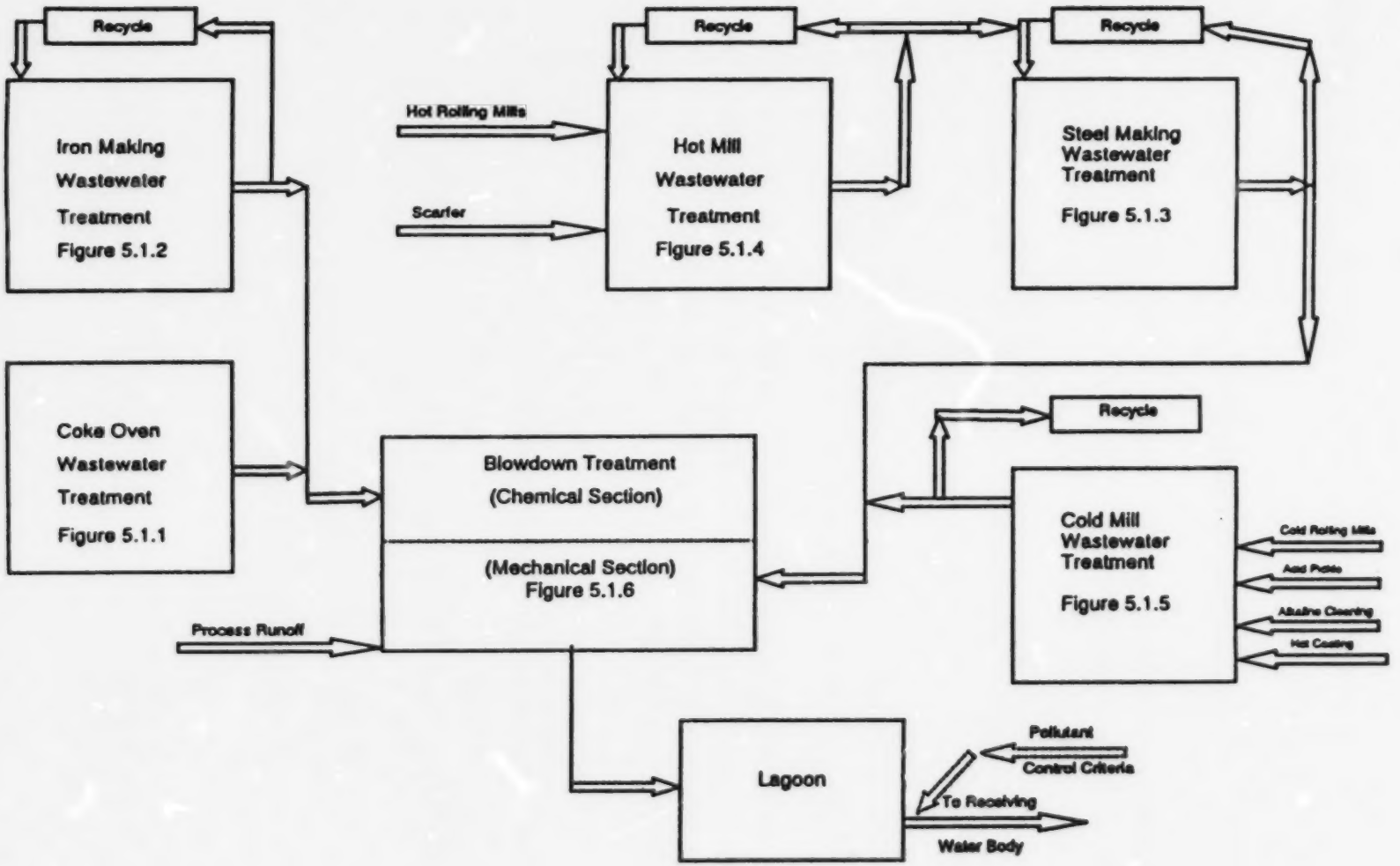

Figure: 5.3.1: Sequential Integrated Wastewater Treatment System

TABLE 2.2.1 **BLOWDOWN FLOWS FROM UNIT PROCESS WASTEWATER TREATMENT PLANTS TO BLOWDOWN TREATMENT AND FINAL DISCHARGE**

Unit process treatment plant	Flow (L/tonne crude steel)
By-product coke plant	120
Blast furnace	230
Steel making	340
Hot forming (balance that is not cascaded to steel-making)	280
Miscellaneous sources (1) (estimated 25%)	240
TOTAL (2) (3)	1,210

(1) Includes blowdowns from cooling towers, boiler feedwater system, coke plant sumps and pump and tank pads and miscellaneous other sources.

(2) Does not include the process run-off water that is site-specific and the quantity varies with the area precipitation and plant layout.

(3) Does not include cold-forming blowdown which should be added based on the specific cold-forming production processes and capacities that are included in the plant.

TABLE 2.2.2 **PROPOSED POLLUTION CONTROL CRITERIA FOR WASTEWATER DISCHARGE TO THE RECEIVING WATER BODY FOR GROUP 1 POLLUTANTS (1)**

Pollutant	Concentration (mg/L)	Process Weight (g/tonne of crude steel)	
	Maximum Daily	Day (2)	30 day (3)
Model process flow (L/tonne crude steel)		1,210	
pH (units)		6.0 to 8.5	
Total suspended solids	10.0	12.1	6.0
Oil and grease	1.5	1.8	.....
Ammonia - N	1.0	1.2	0.6
Cyanides (total)	0.08	0.097	0.05
Phenols	0.005	0.006	0.0030
Benzene	0.002	0.0024	0.0012
Naphthalene	0.002	0.0024	0.0012
Benzo(a)pyrene	0.0006	0.0007	0.0003
Total residual chlorine	0.015	0.018	0.009
Chromium (total)	0.05	0.060	0.030
Lead (total)	0.15	0.18	0.090
Zinc (total)	0.18	0.22	0.11

Toxicity: The wastewater is to meet the following toxicity criteria:

Fish Toxicity Test Flow-through bioassay to meet 96-h LC_{50} at 100 percent (i.e. 96 hour fish bioassay measure be non-toxic at 100 percent strength wastewater)

Daphnia Magna acute lethality toxicity static bioassay to meet 96-h LC50 at 100 percent

(1) Does not include blowdown from cold forming or process run-off water or provision for evaporation from lagoon or precipitation into lagoon

(2) Maximum for one day

(3) Average for 30 consecutive days

TABLE 2.2.3 **PROPOSED POLLUTION CONTROL CRITERIA FOR WASTEWATER DISCHARGE TO THE RECEIVING WATER BODY FOR GROUP 2A POLLUTANTS**

Pollutant	Concentration (ug/L) Maximum Daily	Process Weight (g/tonne crude steel) 30-day average
Acenaphthene	0.7	0.00050
Acenaphthylene	0.4	0.00028
Anthracene	0.2	0.00014
Benzo(a)anthracene	0.2	0.00014
Benzo(b)fluoranthene	0.4	0.00028
Benzo(g,h,i)perylene	0.4	0.00028
Benzo(k)fluoranthene	0.4	0.00028
Bis(2-ethylhexyl)phthalate	1.4	0.0010
4-Bromophenyl phenyl ether	0.4	0.00028
Benzylbutylphthalate	0.6	0.00042
Camphene	1.0	0.00070
1-Chloronaphthalene	0.8	0.00056
2-Chloronaphthalene	0.9	0.00063
4-Chlorophenyl phenyl ether	0.9	0.00063
Bis(2-chloroisopropyl)ether	1.5	0.0011
Bis(2-chloroethyl)ether	1.8	0.0013
Bis(2-chloroethoxy)methane	1.3	0.00091
Chrysene	0.3	0.00021
Dibenz(a,h)anthracene	0.4	0.00028
1,2-Dichlorobenzene	0.02	0.00014
1,4-Dichlorobenzene	0.02	0.00014
Hexachlorobenzene	0.02	0.00014
Pentachlorobenzene	0.02	0.00014
Tetrochlorobenzene	0.02	0.00014
Trichlorobenzene	0.02	0.00014
Di-n-butylphthalate	1.1	0.00077
Di-n-octylphthalate	0.8	0.00056
2,4-Dinitrotoluene	0.5	0.00035
2,6-Dinitrotoluene	0.6	0.00042

TABLE 2.2.3 (continued) PROPOSED POLLUTION CONTROL CRITERIA FOR WASTEWATER DISCHARGE TO THE RECEIVING WATER BODY FOR GROUP 2A POLLUTANTS

Pollutant	Concentration (ug/L) Maximum Daily	Process Weight (g/tonne crude steel) 30-day average
Dioxins (1)	0.000015	0.015×10^{-6}
Diphenylamine	1.9	0.0014
Ethylbenzene	0.4	0.00028
Fluoranthene	0.2	0.00014
Fluorene	0.4	0.00028
Furans (1)	0.000015	0.015×10^{-6}
Indeno(1,2,3-cd)pyrene	0.6	0.00042
Indole	1.2	0.00084
1-Methyl naphthalene	2.2	0.0016
2-Methyl naphthalene	1.5	0.0011
Methylene chloride	1.3	0.00091
5-Nitroacenaphthne	1.8	0.0013
N-nitrosodiphenylamine	1.9	0.0014
N-nitrosodi-n-propylamine	2.1	0.0015
Perylene	0.3	0.00021
Phenanthrene	0.3	0.00021
Pyrene	0.3	0.00021
Styrene	0.4	0.00028
Toluene	0.4	0.00028
Xylene-o	0.4	0.00028
Xylene-m and p	0.5	0.00035

Notes: (1) Toxic equivalent factor (TEF), NATO Protocol

TABLE 2.2.4 **PROPOSED POLLUTION CONTROL CRITERIA FOR WASTEWATER DISCHARGE TO THE RECEIVING WATER BODY FOR GROUP 2B POLLUTANTS**

Pollutant (1)	Concentration (mg/L) Maximum Daily	Process Weight (g/tonne crude steel) 30-day average
Aluminum	0.1	0.07
Antimony	0.05	0.035
Arsenic	0.04	0.028
Beryllium	0.02	0.014
Cadmium	0.001	0.0007
Cobalt	0.1	0.07
Copper	0.1	0.07
Mercury	0.001	0.0007
Molybdenum	0.1	0.07
Nickel	0.2	0.14
Phosphorus as P	0.5	0.35
Selenium	0.01	0.007
Tin	0.2	0.14
Vanadium	0.1	0.07

(1) Total unless otherwise specified

TABLE 2.2.5 **PROPOSED POLLUTION CONTROL MEASURES FOR PROCESS RUN-OFF WASTEWATER FROM BENZENE HANDLING OPERATIONS (OVER 2% BENZENE CONTENT)**

Operation	Control Measure
Pumps	Locate on curbed concrete pads with drains to the process water sewer that goes to the central wastewater treatment plant.
Storage Tanks	Locate on curbed concrete pads with drains to the process water sewer that goes to the central wastewater treatment plant. The storage tank pads should be so designed that spills are contained and the spill liquid reclaimed for recycling or treatment.

2.2.1.1 Precipitation Run-off Water

The model process also includes a lagoon for the precipitation run-off water with a retention time of five days. The proposed pollution control criteria, concentration only, contained in Tables 2.2.2, 2.2.3 and 2.2.4 would apply to all discharges from this lagoon. If the discharge value exceeds the proposed pollution control criteria, the source of the pollution would have to be located and either eliminated or diverted to one of the treatment plants.

2.2.2 Air emissions:

The proposed pollution control criteria for the air emissions have been developed for each unit production and utility process. These criteria are shown in Tables 2.2.7 (sinter plant), 2.2.8 (by-product coke plant), 2.2.11 (blast furnace), 2.2.13 (steel making), 2.2.15 (hot forming), 2.2.16 (cold forming) and 2.2.17 (boiler house).

Specific pollution control measures for fugitive-type sources of air emissions are shown in Tables 2.2.6 (raw materials handling and storage), 2.2.9 (by-product coke ovens), 2.2.10 (benzene emissions from the coke by-product plant area), 2.2.12 (blast furnace), 2.2.14 (steel making) and 2.2.18 (non-process fugitive emissions).

TABLE 2.2.6 PROPOSED POLLUTION CONTROL MEASURES FOR EMISSIONS FROM RAW MATERIALS HANDLING AND STORAGE

Operation	Air Pollution Control Measure
Storage pile design	Storage pile configurations to be designed to minimize particulate emissions due to wind action. Computer modelling of wind action on coal piles should be used in the design of the coal pile configuration.
Coal handling	Wind fences to be used at working face of coal piles. Movement of coal to be discontinued during periods of high wind. Dust suppressant (non-oil bearing) to be used to minimize particulate emissions from coal storage and coal-handling traffic.

TABLE 2.2.7 PROPOSED POLLUTION CONTROL CRITERIA FOR EMISSIONS FROM THE SINTER PLANT (BAT)

Process or operation	Pollutant	Technology	Concentration (mg/Nm^3)
Sinter (1) wind-box	Particulate	Fabric filter (2)	25
	Manganese	Fabric filter	0.13
	Fluoride as F	Raw material	0.10
	SO_x	Low S fuel	450
	NO_x	Burner design	350
Sinter discharge	Particulate	Fabric filter	20
Sinter cooler	Particulate	Fabric filter	20
Sinter building fugitives	Particulate	Fabric filter	20
Sinter crushing and screening	Particulate	Fabric filter	20
LAER:			
Sinter wind-box	SO_x	Flue gas Desulphurization	50
	NO_x	Selective ammonia catalytic reduction	100

(1) Opacity not to exceed 20 percent over a six-minute average.

(2) Wet scrubber may have to be used if oily mill scale is included in the feed:

Particulate	Wet scrubber	40

TABLE 2.2.8 **PROPOSED POLLUTION CONTROL CRITERIA FOR EMISSIONS FROM THE BY-PRODUCT COKE PLANT (EXCLUDING BENZENE) (BAT)**

Process or operation	Pollutant	Technology	Concentration (mg/Nm^3)
Coal crushing and handling	Particulate	Fabric filter	20
Coal preheating	Particulate	Wet Scrubber	30
Pushing	Particulate	Hood or shed with fabric filter	20
Wet quenching	Particulate	Multiple baffles	40
Combustion stack	Particulate	Operating practice & maintenance	35
	SO_x	Desulphurize coke oven gas	20
	NO_x	Combustion practice	250
Coke crushing and screening	Particulate	Fabric filter	20
LAER:			
Dry quenching	Particulate	Enclosed pushing & wet scrubber	40
Combustion stack	NO_x	Selective ammonia catalytic reduction	75

TABLE 2.2.9 **PROPOSED AIR POLLUTION CONTROL MEASURES FOR THE BY-PRODUCT COKE OVEN PLANT (LAER)**

Operation	Air Pollution Control Measure
Charging	Visible emissions not to exceed an aggregate time of 55 seconds for any five consecutive charges. At least one set of observations to be taken each day.
Door leaks	No more than five percent of observed doors to be leaking at any one time (excluding last oven charged). At least one set of observations to be taken each day.
Lid leaks	No more than one percent of observed lids to be leaking at any one time. At least one set of observations to be taken each day.
Off-take piping	No more than four percent of off-takes to be leaking at any one time (excluding three ovens). At least one set of observations to be taken each day.
Collection main(s)	No visible emissions.
Pushing	Opacity not to exceed 20 percent except for the quench car travel for which the opacity is not to exceed 10 percent.
Combustion stack	Opacity not to exceed 20 percent except for a maximum of three minutes in 60 minutes when opacity is not to exceed 40 percent.
Coke oven gas	Total sulphur content of the coke oven gas not to exceed 100 mg/Nm^3.
Wet quenching *	Quench tower to be designed with multiple rows of baffles, mist suppression, facility for emission testing and clean water make-up.
Coke oven gas *	No discharge of coke oven gas to the atmosphere. Coke oven gas flares of approved design to be used.
Note: *	BAT

TABLE 2.2.10 **PROPOSED POLLUTION CONTROL MEASURES FOR FUGITIVE-TYPE BENZENE EMISSIONS FROM THE BY-PRODUCT COKE OVEN PLANT (LAER)**

Source or operation	Measure
Light oil storage tanks, flushing liquor circulation tank, light oil condenser, light oil decanter, wash oil decanter or wash oil tank.	Inert gas blanketing with gases ducted to a benzene recovery or destruction system. *
Light oil truck loading station.	Vapour balance system.
Light oil, wash oil pump sumps.	Sump to be enclosed with provision for venting to benzene recovery or destruction system. *
Pumps, exhauster and booster.	Equipped with double seals to prevent any benzene leak.
Process or equipment benzene leaks.	Standard operating procedure to identify and eliminate benzene leaks.
* Benzene vapour destruction	Thermal destruction at a temperature in excess of 700°C in a smokeless flare or direct-flame incinerator with a destruction efficiency in excess of 98 percent.

TABLE 2.2.11 **PROPOSED POLLUTION CONTROL CRITERIA FOR EMISSIONS FROM THE BLAST FURNACE (BAT)**

Process or operation	Pollutant	Technology	Concentration (mg/Nm^3)
Raw materials handling	Particulate	Fabric filter	20
Cast house	Particulate	Fabric filter	20
Slag pouring or granulating	Particulate	Hood & wet scrubber	30
Slag crushing and screening	Particulate	Fabric filter	20
Hot metal desulphurization	Particulate	Fabric filter	20
Combustion stack (stoves)	Particulate	Use of clean gas & maintenance	10
	NO_x	Combustion practise	80
	Dioxins (1)		0.5×10^{-6}
Ladle de-kishing	Particulate	Fabric filter	20

(1) Toxic equivalent factor (TEF) NATO Protocol

TABLE 2.2.12 PROPOSED AIR POLLUTION CONTROL MEASURES FOR THE BLAST FURNACE (BAT)

Operation	Air Pollution Control Measure
Cast house	Tapping operation, iron and slag runners to be hooded and evacuated to control equipment; runner length minimized; hood iron pouring into ladle. Opacity of cast house roof monitors not to exceed 15 percent over a six-minute period.
Slag quenching	Slag to be granulated or pelletized in enclosed facility with gas cleaning. or Air cooled in slag pit until slag is below TRS formation temperature, then quench with recycled quench water and make-up from blast furnace gas cleaning water. Slag pit to have impervious lining with sumps to retain excess quenching water.
Ladle de-kishing	Ladle de-kishing operation to be hooded and gases cleaned. De-kishing of ladles to be scheduled to minimize kish emissions from ladles.
Blast furnace slips	To be minimized and reported.

TABLE 2.2.13 **PROPOSED POLLUTION CONTROL CRITERIA FOR EMISSIONS FROM STEEL MAKING (BAT)**

Process or operation	Pollutant	Technology	Concentration (mg/Nm^3)
Raw materials handling	Particulate	Fabric filter	20
Basic oxygen furnace			
Melting & refining	Particulate	High energy wet scrubber	35
	Copper	"	0.04
	Cadmium	"	0.0008
	Manganese	"	0.8
	Zinc	"	1.6
	Dioxins (1)		0.5×10^{-6}
Charging	Particulate	Fabric filter	20
Tapping	Particulate	Fabric filter	20
Slagging	Particulate	Fabric filter	20
Hot metal transfer	Particulate	Fabric filter	20
Ladle metallurgy (Elect. furnace)	Particulate	Fabric filter	20
Slag crushing and screening	Particulate	Fabric filter	20

LAER: Basic oxygen furnace carbon monoxide recovered for fuel.

(1) Toxic equivalent factor (TEF) NATO Protocol

TABLE 2.2.13 (continued) PROPOSED POLLUTION CONTROL CRITERIA FOR EMISSIONS FROM STEEL MAKING (BAT)

Process or operation	Pollutant	Technology	Concentration (mg/Nm^3)
Electric arc furnace			
Melting, refining charging, tapping, & slagging	Particulate	Direct evacuation, fabric filter with auxiliary or canopy hood and fabric filter	20
	Copper	"	0.01
	Cadmium	"	0.0004
	Manganese	"	2.0
	Zinc	"	2.6
	Dioxins (1)		0.5×10^{-6}
Slag crushing and screening	Particulate	Fabric filter	20
LAER			
Melting, refining charging, tapping, & slagging	Particulate	Direct evacuation, fabric filter with auxiliary or canopy hood and fabric filter	12

(1) Toxic equivalent factor (TEF) NATO Protocol

TABLE 2.2.14 PROPOSED AIR POLLUTION CONTROL MEASURES FOR STEEL MAKING

Operation	Control Measure
Basic oxygen furnace:	
Primary stack and roof monitor	Opacity not to exceed 10 percent over a six minute period except 20 percent over a six minute period once each cycle.
Electric Furnace:	
Primary stack	Opacity not to exceed 5 percent over a six minute period.
Roof monitor	Opacity not to exceed 10 percent over a six minute period.

TABLE 2.2.15 PROPOSED POLLUTION CONTROL CRITERIA FOR EMISSIONS FROM HOT FORMING (BAT)

Process or operation	Pollutant	Technology	Concentration (mg/Nm^3)
Reheating furnace	Particulate	Burner design, fuel selection	10
	SO_x	Fuel selection	20
	NO_x	Fuel selection, burner design	100
Scarfer	Particulate	Wet electrostatic precipitator	25
LAER:			
Reheating furnaces	NO_x	Selective ammonia catalytic reduction	30

TABLE 2.2.16 **PROPOSED POLLUTION CONTROL CRITERIA FOR EMISSIONS FROM COLD FORMING (BAT)**

Process or operation	Pollutant	Technology	Concentration (mg/Nm^3)
Cold rolling	Oil mist	Mist eliminator	15
Acid pickling	Particulate	Packed bed scrubber	20
	HCl fumes	"	5
Acid regeneration	Particulate	Packed bed scrubber	20
	HCl fumes	"	5
Annealing furnaces	Particulate	Burner design, fuel selection	10
	SO_x	Fuel selection	10
	NO_x	Fuel selection, burner design	100
Hot coating	Particulate	Packed bed scrubber	20
LAER:			
Annealing	NO_x	Selective ammonia catalytic reduction	40

TABLE 2.2.17 **PROPOSED POLLUTION CONTROL CRITERIA FOR EMISSIONS FROM THE CENTRAL BOILER HOUSE (BAT)**

Process or operation	Pollutant	Technology	Concentration (mg/Nm^3)
Combustion	Particulate	Fuel selection	40
	SO_x	Fuel selection	10
	NO_x	Fuel selection	270

Note: Based on the use of approximately 40 percent blast furnace gas and balance de-sulphurized coke oven gas.

TABLE 2.2.18 PROPOSED POLLUTION CONTROL MEASURES FOR NON-PROCESS FUGITIVE EMISSIONS

Operation or area	Proposed control measure
Plant roadways:	All heavily-travelled plant roadways are to be paved and mechanically cleaned on a routine basis in dry weather to prevent dust build-ups that result in fugitive emissions. Roadways that are not paved are to be treated with a non-polluting dust suppressant during dry weather.
Parking lots:	Same as plant roadways.
Material transport:	Vehicles transporting materials - especially those that are prone to particulate emissions - are to be enclosed.
Trucks:	Trucks and other heavy vehicles that travel in areas where they pick up extraneous material are to be washed before leaving the plant. A vehicle washing station is to be installed for this purpose at the exit of the plant to avoid the deposit of particulate material on roadways outside the plant.

2.2.3 Solid Waste:

All wastes including solid wastes are subject to provisions of the Province of British Columbia's Waste Management Act (effective 1982) and Special Waste Regulation (effective April 1, 1988) under the Act, B.C. Reg. 63/88 O.C. 268/88.

Materials which are special wastes according to the Special Waste Regulation are subject to special requirements for handling, transportation, storage, treatment and disposal. Recycling of special wastes is exempt from the requirements of certain sections of the Waste Management Act and the Special Waste Regulation provided the conditions specified in Section 2(8) of the Regulation are met. Before any waste is managed in British Columbia, it is necessary to determine whether it is a special waste. Some wastes are special waste by definition but most require laboratory testing to determine whether they are special waste.

The significant solid wastes generated in the steel plant are listed in Table 2.2.19 together with recommended management methods. Whichever method is selected for managing the waste, the onus is on the owner of the waste to determine the specific regulatory requirements applicable for that method at that time.

Methods of disposal of non-special waste are relatively simple but those for the Special Wastes are intentionally more involved. In either case the owner of the waste should contact the nearest office of the Waste Management Branch to discuss the possible management options. Table 2.2.19 should be used as a guideline.

TABLE 2.2.19 SOLID WASTES AND THEIR RECOMMENDED DISPOSAL

Process Unit	Solid Waste	Management Method
Sinter plant	Dust and sludge	Recycle in sinter plant unless so high in alkali such the material cannot be recycled.
Coke oven	Coke breeze	Recycle to coke ovens, use as a reductant in sinter plant or sell to foundries as a reductant.
	Tar	Sell as a by-product to a chemical company, use as a fuel in the plant or use for injection in the blast furnace
	Ammonium sulphate	Sell as by-product
	Light oil	Sell as a by-product
	Elemental sulphur	Sell as a by-product
	Biological treatment plant sludge	Recycle to the coal being charged into the coke ovens
Iron-making	Blast furnace slag	Use as construction aggregate or landfill
	Desulphurization slag	Recycle maximum amount to blast furnace
	Dust catcher material	Recycle to the blast furnace
	Pollution control sludge	Recycle to the sinter plant or briquette and recycle to the blast furnace if feasible, otherwise consider disposal or storage.
Steel-making	Flux handling dust	Recycle to either blast furnace or steel-making furnace as flux.

TABLE 2.2.19 (continued) SOLID WASTES AND THEIR RECOMMENDED DISPOSAL

Process Unit	Solid Waste	Management Method
Steel making	Pollution control sludge (BOF)	Recycle to the sinter plant or briquette and recycle to the blast furnace if feasible, otherwise consider disposal or storage.
	Pollution control dust (EAF)	Recycle if feasible, otherwise consider disposal or storage
	Slag (BOF)	Recycle maximum amount to the blast furnace as flux, for the balance consider disposal or storage.
	Slag (EAF)	Recycle maximum amount, for the balance consider disposal or storage.
	Secondary steel-making slag	Consider disposal or storage.
Hot forming	Mill scale	Recycle to the sinter plant, blast furnace and steel-making furnaces as feasible, for the balance consider disposal or storage.
	Pollution control sludge	Recycle to the sinter plant or briquette and recycle to the blast furnace if feasible, otherwise consider disposal or storage.
Cold forming	Waste pickle liquor (acid)	A listed special waste - Waste Type 81. Disposal is not allowed and the waste must be regenerated in-plant.
	Acid regeneration iron oxide	Sell as by-product or recycle in-plant.

TABLE 2.2.19 (continued) SOLID WASTES AND THEIR RECOMMENDED DISPOSAL

Process Unit	Solid Waste	Management Method
Blowdown treatment plant	Sludge	Consider disposal or storage.
Miscellaneous	Waste oil	A special waste by definition. Recover and process for recycling to cold-rolling mill. If quality specifications in Section 41 of the Special Waste Regulation are met, use as in-plant fuel or ship to an approved oil reclaim firm for processing off-site.
	Refractory material	Recycle in-plant as much as possible, for the balance consider disposal or storage.
	Paper products	Collect and sell maximum amount for recycling, for the balance either incinerate or consider disposal or storage.
	Waste wood	Recycle as much as feasible, for the balance consider disposal or storage.
	Solvents	Recycle or recover in an on-site or off-site facility.
	Laboratory chemicals	Recycle or ship to a recycling firm or consider disposal or storage.
	Steel scrap	Recycle in-plant.

3.0 Proposed Compliance Monitoring Regime

3.1 Introduction

The proposed compliance monitoring regime is composed of three components:

1. Routine compliance monitoring of operations

   - Monitoring that is carried out on a prescribed routine basis to determine compliance with the prescribed pollution control criteria.

2. Spill or upset monitoring of operations

   - Monitoring required after a spill or operational upset that leads or may lead to the operation exceeding the prescribed pollution control criteria.

   - Monitoring required for the start of operations of any new production or pollution control facility.

3. Compliance monitoring in the receiving environment

   - Monitoring required off-site to determine compliance with prescribed pollution control criteria, including:

     . water quality, biota and sediment monitoring in the effluent discharge mixing zone and in the water surrounding the discharge mixing zone.

     . ambient air quality in the territory surrounding the plant site.

     . waste disposal off-site including leachability and leachate monitoring.

Components (1) and (2) are outlined in the following sections. Component (3) will be prescribed by the Ministry of Environment for the specific site.

The compliance monitoring methods will be prescribed by the Ministry of Environment. Typical sampling and analytical methods are outlined in British Columbia's Ministry of Environment documents.

The proposed compliance monitoring regime is designed to determine the quantity of pollutants discharged to the environment and to determine the regulatory compliance to the pollution control criteria.

A second level of monitoring is the voluntary wastewater monitoring at the operational level (discharge from process wastewater treatment plants). The results from this monitoring level identify operational problems, upsets or spills that may cause the final wastewater discharge to exceed the pollution control criteria.

The proposed compliance monitoring regime for wastewater is outlined in Section 3.2, for air emissions in Section 3.3 and for solid waste in Section 3.4.

3.2 Wastewater Discharge

The proposed compliance monitoring regimes for Group 1 pollutants are shown in Table 3.2.1 and for Groups 2 and 3 pollutants in Tables 3.2.2 and 3.2.3.

The proposed monitoring requirements for the precipitation run-off water are shown in Table 3.2.4.

TABLE 3.2.1 **PROPOSED COMPLIANCE MONITORING FOR WASTEWATER DISCHARGE TO THE RECEIVING WATER BODY FOR GROUP 1 POLLUTANTS (1)**

Pollutant or parameter	Concentration	Process Weight (2)
Effluent flow	C	D
pH	C	.....
Total suspended solids	D	D
Oil and grease	D	D
Ammonia - N	D	D
Cyanides (total)	D	D
Phenols	D	D
Benzene	D	D
Naphthalene	D	D
Benzo(a)pyrene	D	D
Total residual chlorine	C	D
Chromium (total)	D	D
Lead (total)	D	D
Zinc (total)	D	D
LC_{50} Fish Toxicity Test	C	.....
Daphnia Magna Acute Lethality Toxicity Test	D	.....

C Continuous monitoring

D Daily composite (0.00 hrs to 24.00 hrs)

(1) Proposed pollution control criteria in Table 2.2.2

(2) Process weight calculated on daily basis from results of daily composite and daily production of crude steel

TABLE 3.2.2 **PROPOSED COMPLIANCE MONITORING FOR WASTEWATER DISCHARGE TO THE RECEIVING WATER BODY FOR GROUP 2A POLLUTANTS (1)**

Pollutant	Concentration	Process Weight
Acenaphthene	Q	Q
Acenaphthylene	Q	Q
Anthracene	Q	Q
Benzo(a)anthracene	Q	Q
Benzo(b)fluoranthene	Q	Q
Benzo(g,h,i)perylene	Q	Q
Benzo(k)fluoranthene	Q	Q
Bis(2-ethylhexyl)phthalate	Q	Q
4-Bromophenyl phenyl ether	Q	Q
Benzylbutylphthalate	Q	Q
Camphene	Q	Q
1-Chloronaphthalene	Q	Q
2-Chloronaphthalene	Q	Q
4-Chlorophenyl phenyl ether	Q	Q
Bis(2-chloroisopropyl)ether	Q	Q
Bis(2-chloroethyl)ether	Q	Q
Bis(2-chloroethoxy)methane	Q	Q
Chrysene	Q	Q
Dibenz(a,h)anthracene	Q	Q
1,2-Dichlorobenzene	Q	Q
1,4-Dichlorobenzene	Q	Q
Hexachlorobenzene	Q	Q
Pentachlorobenzene	Q	Q
Tetrochlorobenzene	Q	Q
Trichlorobenzene	Q	Q
Di-n-butylphthalate	Q	Q
Di-n-octylphthalate	Q	Q
2,4-Dinitrotoluene	Q	Q
2,6-Dinitrotoluene	Q	Q

See end of table for notes.

TABLE 3.2.2 (continued) PROPOSED COMPLIANCE MONITORING FOR WASTEWATER DISCHARGE TO THE RECEIVING WATER BODY FOR GROUP 2A POLLUTANTS (1)

Pollutant	Concentration	Process Weight
Dioxins (2)	Q	Q
Diphenylamine	Q	Q
Ethylbenzene	Q	Q
Fluoranthene	Q	Q
Fluorene	Q	Q
Furans (2)	Q	Q
Indeno(1,2,3-cd)pyrene	Q	Q
Indole	Q	Q
1-Methyl naphthalene	Q	Q
2-Methyl naphthalene	Q	Q
Methylene chloride	Q	Q
5-Nitroacenaphthne	Q	Q
N-Nitrosodiphenylamine	Q	Q
N-Nitrosodi-n-propylamine	Q	Q
Perylene	Q	Q
Phenanthrene	Q	Q
Pyrene	Q	Q
Styrene	Q	Q
Toluene	Q	Q
Xylene-o	Q	Q
Xylene-m and p	Q	Q

Q Average of daily composites for seven consecutive days once each quarter

Process weight calculated on basis of average of daily composites and quarter's crude steel production

See next page for notes.

TABLE 3.2.2 (continued) PROPOSED COMPLIANCE MONITORING FOR WASTEWATER DISCHARGE TO THE RECEIVING WATER BODY FOR GROUP 2A POLLUTANTS (1)

NOTES:

(1) Proposed pollution control criteria in Table 2.2.3

(2) Toxic equivalent factor (TEF), NATO Protocol

(3) If the pollution control criterion for a pollutant is exceeded for any monitoring period, the monitoring for that pollutant will continue on a daily basis until the pollution control criterion has been met for a 30-day consecutive period (average).

(4) If the monitoring results for any pollutant(s) are shown to have a positive correlation with the monitoring results of one or more pollutants in Table 2.2.1, the monitoring frequency for that pollutant(s) can be relaxed to one monitoring period a year.

TABLE 3.2.3 **PROPOSED COMPLIANCE MONITORING FOR WASTEWATER DISCHARGE TO THE RECEIVING WATER BODY FOR GROUP 2B POLLUTANTS (1)**

Pollutant (2)	Concentration	Process Weight
Aluminum	Q	Q
Antimony	Q	Q
Arsenic	Q	Q
Beryllium	Q	Q
Cadmium	Q	Q
Cobalt	Q	Q
Copper	Q	Q
Mercury	Q	Q
Molybdenum	Q	Q
Nickel	Q	Q
Phosphorus as P	Q	Q
Selenium	Q	Q
Tin	Q	Q
Vanadium	Q	Q

NOTES:

(1) Proposed pollution control criteria in Table 2.2.4

(2) Total unless otherwise specified

(3) If the pollution control criterion for a pollutant is exceeded for any monitoring period, the monitoring for that pollutant will continue on a daily basis until the pollution control criterion has been met for a 30-day consecutive period (average).

(4) If the monitoring results for any pollutant(s) are shown to have a positive correlation with the monitoring results of one or more pollutants in Table 2.2.4, the monitoring frequency for that pollutant(s) can be relaxed to one monitoring period a year.

Precipitation Run-off

The proposed compliance monitoring regime for the precipitation run-off water for the pollution control parameters shown in Table 2.2.1 is shown in Table 3.2.4.

TABLE 3.2.4 **PROPOSED COMPLIANCE MONITORING FOR PRECIPITATION RUN-OFF DISCHARGE TO THE RECEIVING WATER BODY FOR GROUP 1 POLLUTANTS (1)**

Pollutant or parameter	Concentration
Effluent flow	D (2)
pH	D (2)
Total suspended solids	D (2)
Oil and grease	D (2)
Ammonia - N	D (2)
Cyanides (total)	(3)
Phenols	(3)
Benzene	(3)
Naphthalene	(3)
Benzo(a)pyrene	(3)
Chromium (total)	(3)
Lead (total)	(3)
Zinc (total)	(3)
LC_{50} Fish Toxicity Test	(4)
Daphnia Magna Acute Lethality Toxicity Test	(4)

D Daily composite (0.00 hrs to 24.00 hrs)

(1) Proposed pollution control criteria in Table 2.2.2

TABLE 3.2.4 (continued) PROPOSED COMPLIANCE MONITORING FOR PRECIPITATION RUN-OFF DISCHARGE TO THE RECEIVING WATER BODY FOR GROUP 1 POLLUTANTS

Initial monitoring:

Before any water is released from the precipitation run-off lagoon after any precipitation event, a sample must be taken and analyzed for all pollution control criteria in this Table. If any pollution control criterion is exceeded, no water is to be released without the approval of the appropriate Ministry of Environment official.

Monitoring after precipitation events:

(2) Daily composite until discharge from lagoon ceases.

(3) Daily composite for three consecutive days after each major precipitation event (more than 5.0 mm equivalent precipitation) or until lagoon discharge ceases, whichever occurs first. Minimum of one daily composite for three consecutive days per calendar quarter. If the concentration exceeds the pollution control criteria, daily composite sampling to continue until the pollution control criteria have been met for seven consecutive days or until lagoon discharge ceases, whichever occurs first.

(4) Once each six-month period, at least three months apart. If the discharge fails a toxicity test, it should be repeated for each succeeding precipitation event until criteria are met. Daily monitoring for all other pollutants until the discharge meets the toxicity test criterion.

3.3 Air Emissions

The compliance monitoring methods for air emission are prescribed by the Ministry of Environment.

The emissions from all controlled sources are subject to an emission stack test within 180 days of start-up or major modification and are to be repeated within 60 days if the pollution control criteria for that source are not met. Major modification is defined as a process modification, equipment modification or air pollution control modification that individually or collectively has the potential to increase the air emissions from the individual production unit by more than 20 percent or the total plant by more than five percent.

The emissions from all controlled sources are subject to an emission stack test once each year unless otherwise specified. Emissions from uncontrolled sources such as storage tank vents are to be estimated and emission stack testing will be waived unless requested by the Ministry of Environment.

If for any reason the pollutant control criteria are not met for any emission stack test, the emission stack test will be repeated within 60 days.

The proposed compliance monitoring regime for the individual process units is outlined in the following sections.

TABLE 3.3.1 PROPOSED COMPLIANCE MONITORING REGIME FOR SINTER PLANT EMISSIONS (1)

Process or operation	Pollutant	Frequency
Sinter wind-box	Particulate	A
	Manganese	A (2)
	SO_x	C
	NO_x	Q
	Fluoride as F	A (2)
Sinter discharge	Particulate	A (2)
Sinter building fugitives	Particulate	A (2)
Sinter crushing and screening	Particulate	A (2)

C	Continuous
Q	Once each calendar quarter
A	Once each year, at least six months apart

(1) Proposed pollution control criteria in Table 2.2.7

(2) May be less frequent at the discretion of the Ministry

TABLE 3.3.2 PROPOSED COMPLIANCE MONITORING REGIME FOR BY-PRODUCT COKE PLANT EMISSIONS (1)

Process or operation	Pollutant	Frequency
Coal crushing and handling	Particulate	A (2)
Coal preheating	Particulate	A
Charging (Wet coal)	Particulate	(3)
Door leaks	Particulate	(3)
Lid leaks	Particulate	(3)
Off-takes	Particulate	(3)
Pushing	Particulate	A (3)
Wet quenching	Particulate	A (4)
Combustion stack	Particulate	A (4)
	SO_x	M (5)
	NO_x	A (2)
Coke crushing and screening	Particulate	A (2)
Fugitive emissions	Benzene	(3)

M	Once each calendar month
A	Once each year, at least six months apart

(1)	Proposed pollution control criteria and control measures in Tables 2.2.8, 2.2.9 and 2.2.10
(2)	May be less frequent at the discretion of the Ministry
(3)	Visual inspection daily
(4)	Visual inspection daily, emission stack test annually
(5)	Sulphur content of coke oven gas tested monthly

TABLE 3.3.3 **PROPOSED COMPLIANCE MONITORING REGIME FOR BLAST FURNACE EMISSIONS (1)**

Process or operation	Pollutant	Frequency
Raw materials handling	Particulate	A (2)
Cast house tapping	Particulate	A (2)
Slag pouring	Particulate	A (2)
Slag granulation	Particulate	A (2)
Slag crushing and screening	Particulate	A (2)
Hot metal desulphurization	Particulate	A (2)
Combustion stack	Particulate	A (3)
	NO_x	A (5)
	Dioxins	A (2)
Ladle cleaning	Particulate	A (2)

A	Once each year, at least six months apart
(1)	Proposed pollution control criteria in Table 2.2.11 and control measures in Table 2.2.12
(2)	May be less frequent at the discretion of the Ministry
(3)	Visual inspection daily, annual stack test may be waived
(5)	Annual stack test may be waived

Blast furnace slips to be reported daily

TABLE 3.3.4 **PROPOSED COMPLIANCE MONITORING REGIME FOR STEEL-MAKING EMISSIONS (1)**

Process or operation	Pollutant	Frequency
Raw materials handling	Particulate	A (2)
Melting & refining	Particulate	A (3)
	Copper	A (2)
	Cadmium	A (2)
	Manganese	A (2)
	Zinc	A (2)
	Dioxins	A (2)
Charging	Particulate	A (2)
Tapping	Particulate	A (2)
Slagging	Particulate	A (2)
Hot metal transfer	Particulate	A (2)
Slag crushing	Particulate	A (2)
Continuous casting	Particulate	A (2)

A Once each year, at least six months apart

(1) Proposed pollution control criteria in Table 2.2.13 and control measures in Table 2.2.14

(2) Stack testing may be less frequent at the discretion of the Ministry

(3) Visual inspection daily, stack testing may be less frequent at the discretion of the Ministry

TABLE 3.3.5 **PROPOSED COMPLIANCE MONITORING REGIME FOR HOT-FORMING EMISSIONS (1)**

Process or operation	Pollutant	Frequency
Reheating furnace	Particulate	A (2)
	SO_x	A (3)
	NO_x	A (4)
Scarfer	Particulate	A (4)

A	Once each year, at least six months apart
(1)	Proposed pollution control criteria in Table 2.2.15
(2)	Annual stack test may be waived for gaseous fuels
(3)	Annual stack test may be waived for fuels with very low or no sulphur content
(4)	Annual stack test may be waived

TABLE 3.3.6 **PROPOSED COMPLIANCE MONITORING REGIME FOR COLD-FORMING EMISSIONS (1)**

Process or operation	Pollutant	Frequency
Cold rolling	Oil mist	A (2)
Acid pickling	Particulate	A (2)
	Acid fume	C
Acid regeneration	Particulate	A (2)
	Acid fume	C
Annealing furnaces	Particulate	A (3)
	SO_x	A (4)
	NO_x	A (2)
Hot coating	Particulate	A (2)

C	Continuous
A	Once each year, at least six months apart

(1)	Proposed pollution control criteria in Table 2.2.16
(2)	Annual stack test may be waived
(3)	Annual stack test may be waived for gaseous fuels
(4)	Annual stack test may be waived for fuels with very low or no sulphur content

TABLE 3.3.7 PROPOSED COMPLIANCE MONITORING REGIME FOR CENTRAL BOILER HOUSE EMISSIONS (BAT) (1)

Process or operation	Pollutant	Frequency
Combustion	Particulate	A (2)
	SO_x	A (3)
	NO_x	A (2)

A	Once each year, at least six months apart
(1)	Proposed pollution control criteria in Table 2.2.176
(2)	Annual stack test may be waived
(3)	Continuous monitoring may be required depending on sulphur content of fuel

3.4 Solid Waste

Laboratory testing may be required for initial screening of all solid wastes to determine whether the wastes are special wastes.

Any treatment and disposal of solid waste on land will require sampling and monitoring of dust, vapours, gases and leachates. Sampling and monitoring of the affected components of the environment such as air, surface and ground waters and soils on the neighbouring properties are also required to determine the impact of the waste management operations on the environment. The sampling and monitoring may encompass all phases of solid waste management on land (i.e., before application or disposal of waste on land, during or after completion of application). Exact details of sampling and monitoring will be determined by the Ministry on a site-specific basis.